

Conservation of cliff dwelling avifauna through community management in Bundelkhand Region of India

Sonika Kushwaha, Akhilesh Kumar, Aman Singh

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Author Affiliation:

Indian Biodiversity Conservation Society, Jhansi-U.P.
Email: ibcsforall@gmail.com

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ABSTRACT

Cliffs have considerable conservation value, as they often support high levels of biodiversity. Because cliffs typically make up a small portion of a landscape and cannot be created or restored, cliff-specialist birds may be particularly vulnerable to habitat change and disturbance. The cliffs are important because they serve as safe sites for the breeding birds and cannot be approached by predators easily. However, they do not have international recognition and are mostly unprotected, except some that come under Forest Department. These cliffs are being destroyed due to rapid stone mining in Bundelkhand Region. The study was drafted to work out on the declining population of avifauna that uses rocky cliffs as habitat. Eleven sites have been identified after exhaustive surveys in the 3 selected districts (Jhansi, Lalitpur and Sagar). Three sites are within the Wildlife Sanctuaries: Mahavir Swami Wildlife Sanctuary, Lalitpur-Uttar Pradesh and Nauradehi Wildlife Sanctuary, Sagar, Madhya Pradesh. Total 108 bird species are recorded in the cliff habitats out of which 45 species have been identified that prefer the rocky surface of the cliffs i.e. the cliff face. The sites are rich in raptor species including, vultures, owls, kites and eagles. The local people were interacted through questionnaires and direct communication in local languages regarding the vultures and other cliff dwellers. On the basis of the interested and experienced people, the establishment of Cliff Management Committees (CMCs) has been undertaken. They have been trained to locate the breeding, roosting and feeding sites in the areas through various field activities as well as to remove the threats. The preservation and sustainable use of resources is imperative for youth as it amplifies the level of awareness on conservation and access to livelihood resources and its sustainable use. This will prove to be a stepping stone in the direction of habitat conservation of a number of cliff dwelling bird species that have very important ecological roles.

Keywords: Cliffs, avifauna, conservation, Cliff management Committees

1. INTRODUCTION

Birds inhabit different habitats, varying from frozen ice lands, hot scorching deserts, rain forests, mountains, wetlands, mangroves, urban and rural areas

and many more. The birds also inhabit the rocky areas that are less studied and less explored. Bundelkhand region is a well known rocky area of India and has a high percentage of barren and uncultivable land. Almost entire region of Bundelkhand (U.P. and M.P.) is prominently of Vindhyan rocks in southern part and Granites of different kinds at different depths with alluvium soils on top mixed with rocky and boulder outcrops here and there. The northern part of Bundelkhand, almost entirely in U.P., is a flat plain. Through the intervening valleys, the rivers flow down over ledges of granite or quartz. North of the hilly region, the granite chains gradually turn into clusters of rocky cliffs (https://niti.gov.in/planningcommission.gov.in/docs/reports/sereport/ser/bndel/stdy_bndel.pdf)

A cliff is a high steep face of rock and is formed by the process of weathering and erosion with the effect of gravity. All over the world, cliffs are well thought-out as distinctive habitats and studied for their formation, biodiversity and mythological features. Cliffs have significant conservation value, as they habitually sustain high levels of biodiversity. They cannot be recreated or restored because it is a very long and time taking process (Covy *et al.*, 2020). The seasonality together with typical geological and geo-morphological features of Bundelkhand region has influenced the floral and faunal ecology. They are important because they serve as safe sites for the birds and other fauna as they cannot be approached by predators easily. However, little or no attention has been paid to the cliffs in this area and they have not been studied in detail. They have neither international recognition nor any protection, except some that come under Forest Department like national parks and Sanctuaries.

Cliffs have fascinated the interest of biologists, geologists and also the rock climbers throughout the world. As per IUCN's habitat classification in 2014, inland cliffs have been recognized as part of the general category of "rocky areas" which are generally defined as high, steep or overhanging face of rock (Datar & Watve, 2018). Larson *et al.* (2000) state that cliffs are a type of rock outcrop that have three vital essentials: a level or sloping platform or plateau at the top; a pediment consisting of base-rock at the bottom; and a vertical or near-vertical part, called the cliff face or free-face in between. Cliffs lack smooth walls and are characterized by crevices, caves and ledges. Rocky cliffs are biologically rich in terms of the number and variety of species they support. This high species diversity is attributable to the existence of a large number of ecological niches. There is no baseline information on the biodiversity occurrence on this habitat. The present study therefore addresses this gap in knowledge and attempts to give an overview of existing studies, faunal aspects and the ecological features of cliff diversity. Several researchers have contributed to the knowledge of cliff faunal diversity particularly the avifauna. In many places, human activities such as trekking and mountaineering on cliffs affect the behavior of the cliff dwelling birds, but in Bundelkhand the disturbances are by the herders and local people who climb the cliffs for fun and leisure. Most notable among cliff research is the study of vultures, which documents them as breeding, roosting and feeding sites of these critically endangered species. The work indicates that cliffs harbor a multitude of rare, endemic and critically endangered avian species and contribute substantially to regional biodiversity.

Study area

Bundelkhand anciently known as Chedi Kingdom (Bundeli) got its name from Bundela Rajputs until the 16th century, during the rule of Chandel Rajputs later on by Bundela Rajputs, known as Jaijak bhukti or Jejaka bhukti is a geographic region of Central India. Bundelkhand lies between 23° 35'-26' N and 78°-82' E. The boundaries of the Bundelkhand region includes the Yamuna and the Ganga plain in the north, the Vindhyan hills and Panna-Ajaigarh ranges in the east, the Sindh and Chambal rivers, and the Malwa and Udaipur-Gwalior regions in the west, the Narmada and tributaries of the Ken and Betwa and the Vindhya Plateau in the south, the Vindychal and Bagelkhand regions with Panna and Ajaygarh ranges in the south and east (https://www.devalt.org/Pdf/Bundelkhand_Docket.pdf). The Bundelkhand region within these boundaries has an area of around 70,000 sq.km. The region stretches over districts of Southern Uttar Pradesh and Northern Madhya Pradesh (Bundelkhand Vikas Nidhi 1990-1991; M.P. Bundelkhand Development Authority 2007). Bundelkhand Region comprises of Jhansi, Lalitpur, Jalaun, Hamirpur, Banda and Mahoba in Uttar Pradesh and Sagar, Chattarpur, Tikamgarh, Panna and Damoh in Madhya Pradesh including parts of Gwalior, Datia, Shivpuri and Chanderi. The principal rivers are the Sindh, Betwa, Ken, Bagahin, Tons, Pahuj, Dhasan, and Chambal. The area taken for study includes Sagar district from Madhya Pradesh while Jhansi and Lalitpur were taken from Uttar Pradesh (Fig.1).



Figure 1: Rocky cliffs in Bundelkhand region

2. METHODOLOGY

The study started with extensive field works so that all the cliffs with rich avifauna were identified. This required regular surveys at appropriate time of the day on foot or vehicles (as feasible). Secondary data was also used to identify the breeding sites in cliffs. The nests were found using a combination of three techniques: (a) Indirect signs such as searching for owls, pellets, prey remains, excreta, and feathers in potential rocky areas; (b) Whitening sign in case of vultures, (c) passive auditory surveys in early morning and late evening, when birds are most vocal (Delgado and Penteriani 2007); and (c) questioning local people. GPS locations of all sites were recorded. For habitat around active sites, a circle with radius of 1 km was plotted centered on each site. For each plot, we estimated the percentage of six different habitat types: (1) agricultural lands, (2) scrublands, (3) Cliffs, (4) water bodies, (5) forests and (6) human settlements. After identification of the cliffs, the local people were interacted through questionnaires and direct communication in local languages regarding the vultures and other cliff dwellers. After interaction with the local people, on the basis of the interested and experienced people, the establishment of Cliff Management Committees (CMCs) was undertaken. Direct Communication with the youths in the study area lead to mobilize them in conservation endeavors. They were trained to locate the breeding, roosting and feeding sites in the areas through various field activities as well as to remove the threats to the breeding, roosting and feeding sites of vultures in the areas by creating co-ordination between various departments. The preservation and sustainable use of resources is imperative for youth as it amplifies the level of awareness on conservation and access to livelihood resources and its sustainable use.

3. RESULT AND DISCUSSION

The avifauna associated with the cliffs was studied for all the parts of the cliff i.e. plateau at the top, base-rock at the bottom and the cliff face. A total of 108 species are recorded (Table 1). Approximately 45 species prefer specifically the rocky surface of the cliffs i.e. the cliff face. Many birds that use cliffs are highly specialized and rely on this habitat type, although others show flexibility in choosing their nesting substrates (Larson *et al.* 2000). The sites are rich in raptor species that includes the Indian Vulture (Critically Endangered), Egyptian vulture (Endangered), Himalayan griffon (Near threatened), Indian Peafowl i.e. the National bird of India and many other rare and lesser known species (Fig.2).

Table 1: Bird species associated with the cliffs

| S.no | Common Name | Zoological Name | R/M | AC | IUCN Status |
|--------------------------|-------------------------------|----------------------------------|-----|----|-------------|
| Phasianidae (5) | | | | | |
| 1. | Grey Francolin | <i>Francolinus pondicerianus</i> | R | C | LC |
| 2. | Jungle bush quail | <i>Perdica asiatica</i> | R | UC | LC |
| 3. | Peacock | <i>Pavo cristatus</i> | R | C | LC |
| 4. | Painted Spurfowl | <i>Gallus lagopus</i> | R | UC | LC |
| 5. | Rock bush quail | <i>(Perdica argoondah)</i> | R | FC | LC |
| Picidae (3) | | | | | |
| 6. | Black-rumped Flameback | <i>Dinopium benghalense</i> | R | C | LC |
| 7. | Yellow-crowned woodpecker | <i>Dendrocopos mahrattensis</i> | R | C | NA |
| 8. | Brown-capped Pygmy woodpecker | <i>Dendrocopos nanus</i> | R | FC | LC |
| Megalaimidae (2) | | | | | |
| 9. | Brown-headed barbet | <i>Megalaima zeylanica</i> | R | FC | NA |
| 10. | Coppersmith Barbet | <i>Megalaima haemacephala</i> | R | C | LC |
| Bucerotidae (1) | | | | | |
| 11. | Indian Grey Hornbill | <i>Ocyrocus birostris</i> | R | FC | LC |
| Coraciidae(1) | | | | | |
| 12. | Indian Roller | <i>Coracias benghalensis</i> | R | C | LC |
| Alcedinidae(1) | | | | | |
| 13. | Common Kingfisher | <i>Alcedo atthis</i> | R | FC | LC |
| Halcyonidae (1) | | | | | |
| 14. | White-throated kingfisher | <i>Halcyon smyrnensis</i> | R | C | LC |
| Cerylidae(1) | | | | | |
| 15. | Pied Kingfisher | <i>Ceryle rudis</i> | R | C | LC |
| Meropidae(2) | | | | | |
| 16. | Green bee-eater | <i>Merops orientalis</i> | R | C | LC |
| 17. | Blue –tailed bee-eater | <i>Merops philippinus</i> | R | C | NA |
| Cuculidae (4) | | | | | |
| 18. | Pied cuckoo | <i>Clamator jacobinus</i> | R | FC | LC |
| 19. | Brain-fever bird | <i>Hierococcyx varius</i> | R | FC | LC |
| 20. | Asian koel | <i>Eudynamis scolopacea</i> | R | C | LC |
| 21. | Grey bellied cuckoo | <i>Cacomantis passerinus</i> | R | UC | LC |
| Centropodidae (1) | | | | | |
| 22. | Greater Coucal | <i>Centropus sinensis</i> | R | C | LC |
| Psittacidae (2) | | | | | |
| 23. | Rose-ringed Parakeet | <i>Psittacula krameri</i> | R | C | LC |
| 24. | Plum-headed Parakeet | <i>Psittacula cyanocephala</i> | R | FC | LC |
| Apodidae (1) | | | | | |
| 25. | House Swift | <i>Apus affinis</i> | R | C | LC |
| Strigidae (6) | | | | | |
| 26. | Indian Scops Owl | <i>Otus bakkamoena</i> | R | FC | LC |
| 27. | Barn Owl | <i>Tyto alba</i> | R | UC | LC |
| 28. | Brown Fish Owl | <i>Ketupa zeylonensis</i> | R | UC | LC |
| 29. | Indian Eagle owl | <i>Bubo bengalensis</i> | R | FC | LC |
| 30. | Brown Hawk Owl | <i>Ninox scutulata</i> | R | UC | LC |
| 31. | Spotted Owlet | <i>Athene brama</i> | R | C | LC |
| Caprimulgidae (1) | | | | | |

| | | | | | |
|-----|-------------------------------|-----------------------------------|---|----|----|
| 32. | Common Indian Nightjar | <i>Caprimulgus asiaticus</i> | R | FC | LC |
| | Columbidae (3) | | | | |
| 33. | Rock Pigeon | <i>Columba livia</i> | R | C | LC |
| 34. | Laughing dove | <i>Streptopelia senegalensis</i> | R | C | LC |
| 35. | Spotted dove | <i>Streptopelia chinensis</i> | R | C | LC |
| | Burhinidae (1) | | | | |
| 36. | Eurasian thick knee | <i>Burhinus oedicnemus</i> | R | C | LC |
| | Accipitridae (12) | | | | |
| 37. | Black Kite | <i>Milvus migrans</i> | R | C | LC |
| 38. | Oriental Honey Buzzard | <i>Pernis ptilorhynchus</i> | R | FC | LC |
| 39. | Crested Serpent Eagle | <i>Spilornis cheela</i> | R | FC | LC |
| 40. | Bonelli's eagle | <i>Hieraaetus fasciatus</i> | R | UC | LC |
| 41. | Short-toed snake eagle | <i>Circaetus gallicus</i> | R | UC | LC |
| 42. | Long-billed Vulture | <i>Gyps indicus</i> | R | UC | CR |
| 43. | Long-legged Buzzard | <i>Buteo rufinus</i> | M | FC | LC |
| 44. | King vulture | <i>Sarcogyps calvus</i> | R | UC | CR |
| 45. | Egyptian vulture | <i>Neophron percnopterus</i> | R | UC | E |
| 46. | Eurasian Griffon | <i>Gyps fulvus</i> | M | UC | LC |
| 47. | Himalayan Griffon | <i>Gyps himalayensis</i> | R | FC | NT |
| 48. | Shikra | <i>Accipiter badius</i> | R | C | LC |
| | Falconidae (2) | | | | |
| 49. | Common Kestrel | <i>Falco tinnunculus</i> | M | FC | LC |
| 50. | Laggar Falcon | <i>Falco jugger</i> | R | UC | LC |
| | Laniidae(2) | | | | |
| 51. | Long-tailed Shrike | <i>Lanius schach</i> | R | C | LC |
| 52. | Bay -backed shrike | <i>Lanius vittatus</i> | R | FC | LC |
| | Corvidae (12) | | | | |
| 53. | Rufous Treepie | <i>Dendrocitta vagabunda</i> | R | C | LC |
| 54. | House crow | <i>Corvus splendens</i> | R | C | LC |
| 55. | Jungle crow | <i>Corvus macrorhynchos</i> | R | C | LC |
| 56. | Ashy Wood swallow | <i>Artamus fuscus</i> | R | FC | LC |
| 57. | Eurasian Golden Oriole | <i>Oriolus oriolus</i> | R | C | LC |
| 58. | Black drongo | <i>Dicrurus macrocerus</i> | R | C | LC |
| 59. | Ashy Drongo | <i>Dicrurus leucophaeus</i> | M | FC | LC |
| 60. | White-bellied drongo | <i>Dicrurus caerulescens</i> | R | UC | LC |
| 61. | Common Iora | <i>Aegithina tiphia</i> | R | FC | LC |
| 62. | White- browed fantail | <i>Rhipidura aureola</i> | R | FC | LC |
| 63. | Common Woodshrike | <i>Tephrodornis pondicerianus</i> | R | FC | LC |
| 64. | Asian Paradise flycatcher | <i>Terpsiphone paradisi</i> | R | FC | LC |
| | Musciapidae (12) | | | | |
| 65. | Grey-headed Canary Flycatcher | <i>Culicicapa ceylonensis</i> | M | FC | LC |
| 66. | Verditer Flycatcher | <i>Eumyias thalassina</i> | M | FC | LC |
| 67. | Tickell's Blue Flycatcher | <i>Cyornis tickelliae</i> | R | FC | LC |
| 68. | Red-throated flycatcher | <i>Ficedula parva</i> | M | FC | LC |
| 69. | Oriental Magpie Robin | <i>Copsychus saularis</i> | R | C | LC |
| 70. | Indian Robin | <i>Saxicoloides fulicata</i> | R | C | LC |
| 71. | Common Stonechat | <i>Saxicola torquata</i> | M | C | LC |
| 72. | Pied Bushchat | <i>Saxicola caprata</i> | R | C | LC |

| | | | | | |
|------|------------------------------|----------------------------------|---|----|----|
| 73. | Blue Rock Thrush | <i>Monticola solitarius</i> | M | UC | LC |
| 74. | Black Redstart | <i>Phoenicurus ochrurus</i> | M | FC | LC |
| 75. | Brown Rock-chat | <i>Cercomela fusca</i> | R | FC | LC |
| 76. | Isabelline Wheatear | <i>Oenanthe isabellina</i> | R | UC | LC |
| | Sturnidae (5) | | | | |
| 77. | Brahminy Starling | <i>Sturnus pagodarum</i> | R | C | LC |
| 78. | Asian pied starling | <i>Sturnus contra</i> | R | C | LC |
| 79. | Common Mynah | <i>Acridotheres tristis</i> | R | C | LC |
| 80. | Bank Mynah | <i>Acridotheres ginginianus</i> | R | C | LC |
| 81. | Chestnut tailed starling | <i>Sturnus malabaricus</i> | R | FC | LC |
| | Paridae (1) | | | | |
| 82. | Great Tit | <i>Parus major</i> | R | FC | LC |
| | Hirundinidae (5) | | | | |
| 83. | Plain Martin | <i>Riparia paludicola</i> | R | C | LC |
| 84. | Wire-tailed Swallow | <i>Hirundo smithii</i> | R | FC | LC |
| 85. | Barn/common Swallow | <i>Hirundo rustica</i> | M | C | LC |
| 86. | Red-rumped Swallow | <i>Hirundo daurica</i> | R | FC | LC |
| 87. | Eurasian crag martin | <i>Hirundo rupestris</i> | R | FC | LC |
| | Pycnonotidae (1) | | | | |
| 88. | Red-vented Bulbul | <i>Pycnonotus cafer</i> | R | C | LC |
| | Cisticolidae (4) | | | | |
| 89. | Jungle Prinia | <i>Prinia sylvatica</i> | R | FC | LC |
| 90. | Ashy Prinia | <i>Prinia socialis</i> | R | C | LC |
| 91. | Plain Prinia | <i>Prinia inornata</i> | R | C | LC |
| 92. | Grey-breasted Prinia | <i>Prinia hodgsonii</i> | R | FC | LC |
| | Zosteropidae (1) | | | | |
| 93. | Oriental White-eye | <i>Zosterops palpebrosus</i> | R | C | LC |
| | Sylviidae (6) | | | | |
| 94. | Common Tailorbird | <i>Orthotomus sutorius</i> | R | C | LC |
| 95. | Common Babbler | <i>Turdoides caudatus</i> | R | FC | LC |
| 96. | Yellow eyed babbler | <i>Chrysomma sinense</i> | R | C | LC |
| 97. | Large Grey Babbler | <i>Turdoides malcolmi</i> | R | C | LC |
| 98. | Jungle Babbler | <i>Turdoides striatus</i> | R | C | LC |
| 99. | Tawny bellied babbler | <i>Dumetia hyperythra</i> | R | UC | LC |
| | Alaudidae (2) | | | | |
| 100. | Rufous-tailed Lark | <i>Ammonomanes phoenicurus</i> | R | FC | LC |
| 101. | Indian bush lark | <i>Mirafra erythroptera</i> | R | FC | LC |
| | Nectariniidae (1) | | | | |
| 102. | Purple Sunbird | <i>Nectarinia asiatica</i> | R | C | LC |
| | Passeridae (5) | | | | |
| 103. | House Sparrow | <i>Passer domesticus</i> | R | C | LC |
| 104. | Chestnut-shouldered Petronia | <i>Petronia xanthocollis</i> | R | FC | LC |
| 105. | White-browed Wagtail | <i>Motacilla maderaspatensis</i> | M | FC | LC |
| 106. | Indian Silverbill | <i>Lonchura Malabarica</i> | R | C | LC |
| 107. | Scaly-breasted Munia | <i>Lonchura punctulata</i> | R | FC | LC |
| | Fringillidae (1) | | | | |
| 108. | Crested bunting | <i>Emberiza lathami</i> | M | FC | LC |

AC-Abundance Code; R-Residential; M-Migratory; C-Common; UC-Uncommon; FC-Fairly Common; R*-Rare; LC-Least Concern, NT-Near Threatened; V-Vulnerable; NA-Not Available.



Rock Eagle owl (*Bubo bengalensis*)



Barn owl (*Tyto alba*)



Common Kestrel (*Falco tinnunculus*)



Bonelli's Eagle (*Hieraaetus fasciatus*)



Egyptian Vulture (*Neophron percnopterus*)



Eurasian Griffon (*Gyps fulvus*) and Himalayan Griffon Vulture (*Gyps himalayensis*)



Indian Vulture (*Gyps indicus*)



Spotted owl (*Athene brama*)

Painted Spurfowl (*Galloperdix lunulata*)Dusky Crag Martin (*Hirundo rupestris*)Indian Peafowl (*Pavo cristatus*)**Figure 2:** Rich Avifauna in rocky cliffs

In addition to the avifauna, the cliffs are supporting the Rock Honey bee (*Apis dorsata*) (Fig.3). *A.dorsata* colonies are declining under natural conditions due to various biological agents and unwanted man-made activities at the vicinity of nesting habitats. Honey bee is ranked as most efficient pollinators that are economically important for crops as well as source of honey and wax. They also yield valuable products like royal jelly, bee pollen, propolis and bee venom that have nutritional and medicinal values. The protection of *Apis dorsata* nesting on rock faces of cliffs is crucial for maintaining the viable populations of these keystone pollinators (Kushwaha, 2016).

**Figure 3:** Beehive in cliffs

Gray langurs, also called Hanuman langurs, monkeys, Indian jackal, wild boar, Monitor lizards and snake species were also commonly seen in the microhabitat of the rocky cliffs (Fig.4). Further exhaustive surveys may reveal may more species that are using the cliffs as their natural abodes.



Figure 4: Diverse fauna associated with the rocky cliffs

The cliffs are serving as important breeding, feeding and roosting sites for the birds (Fig.5). The nests are built on the ledges or in cavities and small caves on cliffs that well protected from predators. The barn owls and the spotted owlets find the cliffs ideal for nesting in the holes in the rocky surface. The dead cattle are often thrown outside the village at the base of the cliffs. Vultures feed on the carcass and use the cliffs to rest for long hours to digest the food and sometimes they also sun bask on the rocky cliffs before taking the flights again (Fig.6).

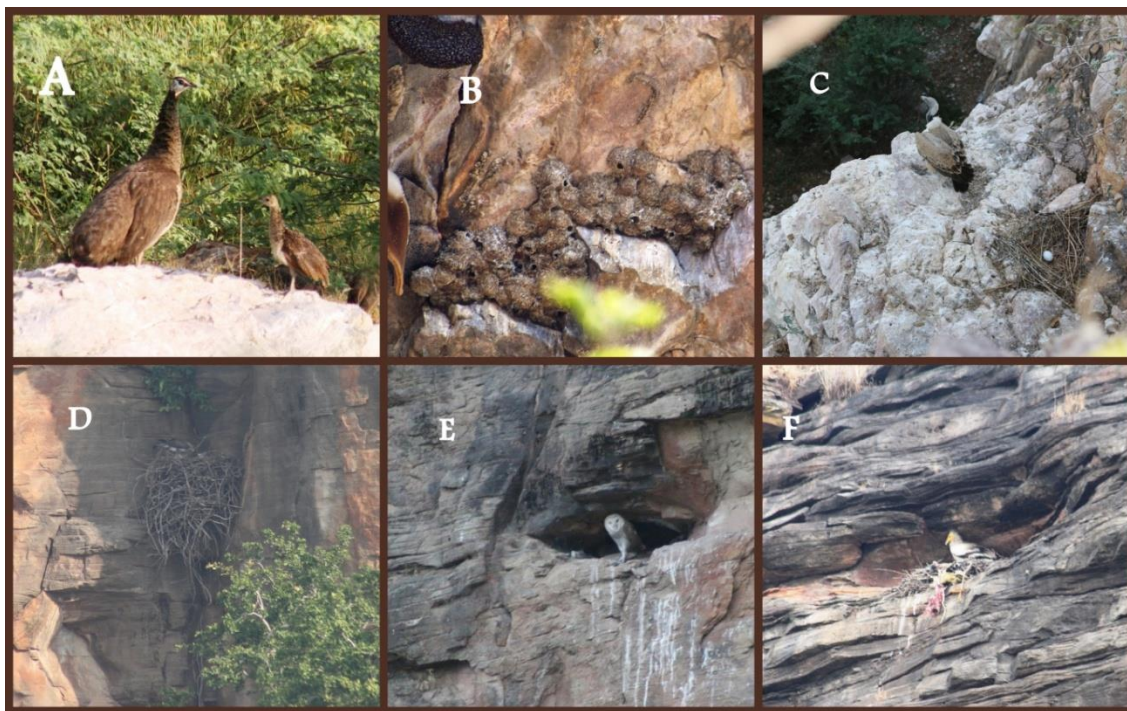


Figure 5: Birds nesting in the cliffs. A: Indian Peafowl; B: House swift; C: Indian Vulture; D: Bonelli's Eagle; E: Barn Owl; F: Egyptian Vulture



Figure 6: Vultures roosting on the rocky cliffs

As the majority of rocky faunal communities are adopted to live in the harsh environment and tolerance level reaches to the threshold limit, any introduction of anthropogenic mediated disturbances will further exacerbate the negative impact, which will certainly be catastrophic events of large-scale decimation of faunal communities (Satyam and Thiruchitrabalam, 2018). The mining activities (Stone and sand) are a major threat to the rocky cliffs and river beds in Bundelkhand (Fig.7 & Fig.8). Mining destroys the apt rock formations (*i.e.*, cavities, ledges) where birds like vultures, owls, and eagles construct their nests. The mining activities at a large and unregulated level have direct and indirect effects on the biodiversity in the region. Mining destroys the vegetative cover that has adverse consequences on the food chain as well as the nesting sites of large raptors. It has been recommended in several studies that alteration in the utilization of mountain regions can diminish the carrying capacity of the natural surroundings and the breeding success of birds. Mining of hills for stones used in construction is a major source of deforestation on hills. A fact finding report by the Kashipur Solidarity Group (an association of activists, scientists and environmentalists) in May 2008 pointed out mining at the core of all environmental degradation in the Bundelkhand region (Khurana I. and Mahapatra R. 2008). Likewise, rock and sand mining activities in close proximity to vulture colonies in Nepal (for example in Jyagdi and Khairini, Rampur) have distressed the vulture population (Baral and Gautam, 2007)). The noise pollution caused due to mining, also has adverse effects on the biodiversity in the forests and other areas surrounding the mines/industrial complexes. Wildlife is more sensitive to noise and vibrations than the human beings. Mining activities are not sustainable because besides taking advantage of the non-renewable resources, they leave behind them the ruined habitat and society, which is mostly irremediable. Therefore, due to its impacts, mining is one of those activities that need to be strictly controlled at all stages, from prospection and utilization to transportation, handing out and consumption (Singh *et al.*,2010).



Figure 7: Destruction of Rocky cliffs due to mining



Figure 8: Mining activities are major threat to the cliff biodiversity

Some sites in dense areas are being disturbed due to the encroachment of cliffs by 'sadhus' i.e. saints. The sites get disturbed due to the gathering of the devotees in large numbers. The collection of wood for cooking and the smoke that arises due to cooking also disturbs the birds in cliffs particularly during the breeding period (Kushwaha, 2014). Jain temples in located in Mahavir Swami Sanctuary is a tourist place and is very important for Jains. Sometimes on particular occasions, the tourists pressure increases that results in disturbance to the birds and animals.

Conservation through community management

The initiatives have been undertaken so as to involve the local people to monitor and conserve the cliffs that serve as natural breeding, roosting and feeding sites of diverse avifauna. This will help and promote in *in-situ* conservation. At present scenario, an essential aspect of conservation is the preservation of any remaining valuable habitat if at all possible. Socio-economic factors (e.g., caste, gender, age, education, livestock holding, participation and benefits) have significant influence on conservation attitudes. The initiative has been formulated to form a milestone basis for the implementation of conservation programs in the community, with a more effective conservation of rocky cliffs. Local community plays a key role in conservation of any species and without their involvement. Community-based conservation (CBC), as a means of achieving integrated conservation and development, has emerged as the central exemplar among national and international organizations as well as NGOs. CBC is based on the concept of simultaneous interests of conservation and development (Berkes, 2004). The underlying principle behind CBC is to work together so as to achieve more than that the individuals or organizations can work single-handedly, and the involvement to people concerned will have improved and more adequate outcomes. The expected outcomes will lead to increased acceptance of conservation and participatory activities as a means of achieving the maintenance of biodiversity goals. There are various communities that are known for conservation of various species such as (Pathak, 2009):

1. Protection of sea turtle eggs, hatchlings and nesting sites by fisher folk communities is found at Kolavipaalam in Kerala, Galgibag and Morjim in Goa, and Rushikulya and Gokharkuda in Odisha.
2. Youth clubs from the villages around Loktak Lake (Manipur) have formed the Sangai Protection Forum to conserve the greatly endangered Brow-antlered deer, which is endemic to this wetland.
3. The Buddhist Morpa community in Sangti Valley in Arunachal has co-existed with the endangered black-necked cranes for generations, viewing them as a harbinger of better rice yields.
4. In Khichan village of Rajasthan, the local population provides refuge and food to a wintering population of up to ten thousand demoiselle cranes, ungrudgingly spending up to several hundred thousand rupees annually on food grains to feed them.
5. The Bishnoi community in Rajasthan, famous for its self-sacrificing defense of wildlife and trees, continues strong traditions of conservation.

6. Recently the Sahariya community in Bundelkhand region has started the conservation of vultures residing in the cliffs near their localities.

While these concepts are not new, their application has increased dramatically in the last decade. To achieve the targets interaction was started with people from different fields such as Herders, Farmers, Archaeological guards, Priests, forest officials, teachers and so on (Table 2). People from all fields are directly or indirectly related to the conservation issues and can play an important role in achieving the targets of conservation through community involvement.

Table 2: Involvement of people from different fields for the aim of conservation of cliffs and their Avifaunal diversity

| | |
|------------------------------------|---|
| Teachers | <ul style="list-style-type: none"> • To create awareness • enroll the students in conservation |
| Forest Guards | <ul style="list-style-type: none"> • To monitor the sites • Prevent disturbance by nearby villagers. |
| Archaeological Guards | <ul style="list-style-type: none"> • avoiding disturbance by tourists • promoting eco-tourism |
| Herders | <ul style="list-style-type: none"> • To avoid overgrazing • to avoid disturbance to the ground dwelling birds |
| Priests | <ul style="list-style-type: none"> • To teach people to be passionate towards other living organisms |
| Local communities/villagers | <ul style="list-style-type: none"> • to help in monitoring the sites • to help in rescuing the injured/sick birds |

The school teachers were approached because they are vital in taking the message to the future generation. The teachers play an important role in molding the minds of the students. The impact is long lasting and helps the students to know about various aspects of cliffs at a wider platform. This is important because students who are aware about the degrading biodiversity show a greater positive approach towards conservation. It is important to aware the younger generation about the role of cliffs and to make them understand the ecological and environmental value. For this it is utmost imperative to make contact with the teachers. Youths can be one of the important inputs for the biodiversity conservation. They have sufficient potential and enthusiasm that need to be mobilized for conservation and sustainable livelihood. Enrollment of educated youths can be innovative in improving the life conditions leading to sustainable and compatible development (Kushwaha and Rawat 2016).

These innovations besides being environmentally sustainable generate employment among the youth thereby improving their quality of life. The youth need to be educated about their surrounding Nature, its biodiversity, role of flora and fauna, importance of habitats and the need to conserve them. Education helps to recognize that ecosystems are dynamic, that humans are an integral part of ecosystems, and that human activity has both positive and negative consequences (Kushwaha and Rawat 2016).

Workshops were structured to bring people together to increase knowledge and skills, resolve problems, and build consensus for action.

The communication with people from all areas will help in the conservation of the cliff dwelling fauna. The herders often ignorant about the nesting behaviour of various bird species and unknowingly, their activities are a threat to the bird species. They climb the cliffs along with their herds leading to uncontrolled overgrazing on the floral diversity. The herders are also unaware of the consequences of cutting the tree branches for the livestock. The chopped branches are not suitable for the massive nests constructed by the raptors. While grazing, the herds of goats, sheep or cattle, the nests of ground dwelling birds get destroyed by the hoofs of the animals. Therefore to avoid such situations in future, the herders were involved in the conservation initiatives. The

cultures of various communities not only in India but from all over the world have mentioned about birds and also associated their deities with them like Owls with Goddess Saraswati, peacocks with Lord Krishna, vultures have been mentioned in Ramayan. Therefore the priests of various temples near the cliffs were interacted so that they remind the people about the importance of birds in the environment. Deogarh is famous for the Jain Temples. Jains believe bad karma is caused by harming living things therefore they practice Ahimsa i.e. non violence. The devotees should therefore help in the conservation of fauna. Firstline forest officials were also involved in the vulture conservation initiatives. The Forest Guards being local to the area were involved in this initiative. They have been helpful in regularly monitoring the sites and also helped in identifying new sites in the protected areas. For the conservation of any species of plant or animal or any ecosystem, it is mandatory to involve the local communities. In Bundelkhand region, the Saharia tribes actively volunteer in the monitoring and rescue programmes (Fig.9).





Figure 9: Interaction with local communities and forest staff



Figure 10: Sahariya community

Saharia is primitive and one of the specified backward tribes found in Madhya Pradesh and Uttar Pradesh. The word “Sahria” is the combination of two words like “Sa” (companion) and “Haria” (tiger) which mean companion of tiger (Tiwari, 1984). Saharia are the members who belong to traditional society (Fig.10). All the settlement patterns of the tribe are found on the middle top or on the outskirts of the hill. In every dispersed Saharia village, hamlet or “Phalaya” is regarded as the first ecological unit. Most of the Saharia are depended on ecology which plays an important role in forming their economic structure (Mandal, 1998). Their habitations are located outside the main villages, which is called Saharana. It is generally a cluster of houses. The housing reminds of prehistoric scenes. The Saharias are expert woodsmen and forest produce gatherers. They are particularly skilled in making catechu from khair trees. The main business is gathering & selling of forest wood, Gum, Tendu leaf, Honey, Mahua and medicinal herbs. Their traditional occupations also include making baskets, mining and quarrying, and breaking stones. Basketry is also an important craft of the community (Rajak, 2016). Keeping in mind that conservation through community involvement is the best, Indian Biodiversity Conservation Society ensured to engage the Saharia tribe. This resulted in making members and volunteers from Saharia tribe that are actively supporting in conservation of biodiversity in Bundelkhand (Fig.11). With their timely information, Indian Biodiversity Conservation Society has saved Indian Peafowl, Vultures and owls. Initiatives are being taken so as to promote sustainable development and conservation by promoting eco-tourism in some areas. The youths are being trained in

bird watching so that they can take the profession of Guides for Bird Watching. Projects are being drafted to support them in starting some eco-friendly business like pottery, bio-degradable glasses and plates, products from cow dung. This will motivate them in their initiatives for conservation of the biodiversity of the rocky cliffs around them.



Figure 11: Ramnath and Daya Sagar, two very active members from Saharia tribe

The National Bird Peacock (*Pavo cristatus*) comes under Schedule 1 of Wildlife Protection Act 1972. There have been no scientific censuses for peacock in India as such the current status is not known. However there have been reports of decline from several places. The local people have taken the initiative to protect the birds as they are commonly known to be associated with Lord Krishna in Hindu culture. During morning hours the peafowl come down on the house roofs from the roosting trees and then start moving to the foraging sites. The vibrant birds do not hesitate and move about freely in the agricultural land, outskirts of village and the rocky cliffs in search of food. They feed on insects and do not cause any harm to the crops. By evening they return back to the village and roosts on high trees of neem and chirol. The villagers keep water in earthen pots for them and also provide them grains to feed (Kushwaha *et al.*, 2016). The population of peacock has increased due to protection by local community. An injured peacock was rescued with the help of a volunteer in Babina, Jhansi. Since it is a bird included in Schedule I of Wildlife (Protection) Act, 1972, the Forest department was informed about the incidence (Fig.12).

A rock eagle owl fledgling was also found injured when it was learning to take flight. It was taken to the Forest department for treatment. The fledgling was kept in a well ventilated room so as to protect it from feral dogs and to avoid any sort of disturbance from human presence. The Room was cleaned on alternate days. It was fed on chicken, fish and soya granules. After keeping it for few days, it was released back in its natural habitat (Fig.13).



Figure 12: Rescue of an injured Peacock. A: Peacock seen by a local person; B: examination of the injury; C: Handed to the Forest Staff; D: Taken to the veterinary doctor



Figure 13: Rescue of an injured Rock Eagle Owl

With due permission of the forest department, the vultures are taken care of according to their conditions i.e. injured or dehydrated (Fig.14). There is proper facility to keep the vultures near their natural habitats. The volunteers look after the vultures and are regularly assisted with the vulture experts. The veterinary doctors are consulted in case of injured birds, so as to avoid any mishap. The injured vultures are medicated. The dehydrated vultures are treated with ORS and provided with 200-250 gm of meat at a time. After keeping in observation for a time span of 5-7 days, they are released back in their natural abodes. By rescuing an injured or orphaned wild bird one has already taken the very important first step in saving its life. Effective education and outreach activities play a major role in motivating the people from different fields to join the conservation initiatives by improving their knowledge and behaviour and sharing scientific advances. The mutual initiatives with the local communities have resulted in the conservation of the Mother Nature's cleaners. The ecological position of vultures cannot be substituted by any other species.



Figure 14: Rescue of a dehydrated fledgling of an Indian Vulture

4. CONCLUSION

The most intelligent species on this earth "*Homo sapiens*" are living a life that is self-centred and severely affecting the survival of other species. In the fast developing technological world man is moving away from Nature, exploiting and destructing it. A consequence of man's act is the diminishing population of many species. It is distressing to make them realize the importance of each and every species on the Earth. Man is not ready to do anything until and unless they get monetary benefits. This study however concludes that the people in the study area still have an overall positive attitude towards conservation. The people realize the uncommonness of faunal species in present and their critically endangered status, yet they do not take the conservation initiatives seriously. During the study it has been concluded that there is an urgent need of Cliff Management Committees (CMCs) that will work altruistically for the conservation of rocky cliffs that are full of life due to the rich avifaunal diversity. The co-ordination between the members of CMCs will be crucial and decide the success of these initiatives. In this study area few respondents actively participated in the conservation efforts as they are well aware of the environmental services provided by avifauna be it vultures, owls or peafowl. Considering the potentiality and eagerness of the students in the study area they will be

activated in conservation ventures of cliffs. These efforts will form the milestone basis for the achievement of management programs by the community, with more effectual conservation of cliffs and cliff dwelling avifauna.

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Ethical approval

Cliff dwelling avifauna from Bundelkhand Region of India was observed in the study. The Animal ethical guidelines are followed in the study for species observation & identification.

Conflicts of interests: The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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